THE CLAIMS

What is claimed is:

1. A gas charging system for charging of a gas storage and delivery apparatus including a gas storage and delivery vessel having an interior volume for holding gas for subsequent dispensing, said gas charging system comprising:

(a) a gas source of the gas to be charged to the vessel;

(b) a cryotrap;

(c) a refrigerator unit coupled to the cryotrap and selectively actuatable to supply refrigeration to the cryotrap, and de-actuatable to terminate the supply of refrigeration to the cryotrap;

(d) flow circuitry interconnecting the gas source and cryotrap, arranged for selective initiation of flow of gas from the gas source to the cryotrap, and selection termination of flow of gas from the gas source to the cryotrap, said flow circuitry further coupleable to a vessel to be charged with gas, to interconnect the cryotrap and said vessel, and said flow circuitry being operably arranged for flowing gas to the cryotrap and refrigerating the cryotrap by the refrigerator unit to liquefy gas in the cryotrap, while the flow circuitry is closed to flow between the cryotrap and the vessel, in a first phase of operation, and terminating refrigeration of the cryotrap by the refrigerator unit to warm the cryotrap and gasify liquid therein, with the flow circuitry closed to flow of gas from the gas source to the cryotrap, and open to flow of gasified gas from the cryotrap to the vessel, in a second phase of operation.

2. The gas charging system of claim 1, wherein the flow circuitry includes selectively actuatable flow control valves.

3. The gas charging system of claim 1, wherein the cryotrap includes an interior chamber, and a cold finger member protruding into the interior chamber and present a chilling surface for contacting of gas from the gas source, for liquefaction thereof.

4. The gas charging system of claim 3, wherein the refrigerator unit is coupled to the cold finger

member for flow of refrigerant medium therethrough.

5. The gas charging system of claim 4, wherein the refrigerator unit is adapted to supply said refrigerant medium as a liquid to the cold finger member, wherein said liquid comprises a liquid species selected from the group consisting of liquid nitrogen, liquid oxygen, and liquid fluorine.

6. The gas charging system of claim 1, comprising a controller arranged to control flow of gas through said flow circuitry.

7. The gas charging system of claim 6, wherein the flow circuitry comprises valves for selective initiation or termination of flow of gas through said flow circuitry.

8. The gas charging system of claim 7, wherein said valves comprise automatic valve actuators.

9. The gas charging system of claim 8, wherein said automatic valve actuators comprise pneumatic valve actuators.

10. The gas charging system of claim 8, wherein said automatic valve actuators comprise electrical valve actuators.

11. The gas charging system of claim 1, wherein the flow circuitry is coupled to a said gas storage and dispensing apparatus including a gas storage and dispensing vessel.

12. The gas charging system of claim 11, wherein the gas storage and dispensing apparatus includes a gas dispensing assembly coupled to the gas storage and dispensing vessel, and said gas dispensing assembly includes a regulator.

13. The gas charging system of claim 12, wherein the regulator is interiorly disposed in the gas storage and dispensing vessel.

14. The gas charging system of claim 1, further comprising a sensor arranged for sensing a condition of gas in said charging system.

15. The gas charging system of claim 14, wherein the sensor is arranged for sensing the condition of gas in said flow circuitry.

16. The gas charging system of claim 15, wherein the sensor comprises a pressure transducer sensor for monitoring pressure of gas in the flow circuitry.

17. The gas charging system of claim 16, further comprising a central processing unit (CPU) arranged for controlling operation of said flow circuitry, wherein the pressure transducer sensor is coupled in input signal transmission relationship with the CPU.

18. The gas charging system of claim 17, wherein the CPU is arranged to carry out a predetermined number of liquefaction and gasification steps to fill the gas storage and dispensing vessel to a predetermined pressure level.

19. The gas charging system of claim 1, wherein the gas source comprises a source of a semiconductor manufacturing gas.

20. The gas charging system of claim 1, wherein the gas source comprises a source of a gas selected from the group consisting of arsine, phosphine, stibine, silanes, disilanes, halosilanes, diborane, hydrogen fluoride, boron trichloride, boron trifluoride, hydrogen chloride, and organometallic reagent gases.

21. The gas charging system of claim 1, wherein the gas source comprises a boron trifluoride gas source and the refrigerator unit is arranged to supply liquid nitrogen as a refrigerant medium to said cryotrap.

22. A gas charging system for charging a gas storage and dispensing vessel with gas, said gas charging system comprising:

a gas source comprising gas to be charged to the vessel;

a source/fill line connecting the gas source in flow communication with said vessel;

a cryotrap arranged for selective cooling of gas to liquefy same, and warming of liquefied gas to gasify same;

a valved manifold assembly interconnecting the source/fill line and the cryotrap and arranged to

selectively flow gas from the gas source through the valved manifold assembly to the cryotrap for liquefaction of source gas therein during a first phase of operation, and to selectively flow gasified gas from the cryotrap through the valved manifold assembly to the source/fill line for flow to the vessel during a second phase of operation; and

a controller arranged to operate valves of the valved manifold assembly to conduct said first and second phases of operation in an alternating and repetitive manner, to progressively fill said vessel with gas to a filled state.

23. The gas charging system of claim 22, wherein the controller comprises a central processing unit including a general purpose programmable computer programmably arranged to effect said first and second phases of operation in accordance with a predetermined program.

24. The gas charging system of claim 23, wherein the central processing unit is coupled in signal transmission relationship with the gas source and cryotrap for modulating their operation in accordance with said predetermined program.

25. A method of charging a gas storage and dispensing vessel with a gas to a predetermined pressure level, comprising:

(a) providing source gas;

(b) liquefying said source gas to form a source liquid;

(c) gasifying the source liquid in closed flow communication with the vessel, to flow the gasified gas into the vessel; and

(d) repeating steps (a) - (c) in sequence, for sufficient repetitions to fill the vessel with gasified gas to said predetermined pressure level.

26. The method of claim 25, wherein said liquefying step (b) comprises liquefaction of the source gas in a cryotrap.

27. The method of claim 26, wherein the cryotrap is refrigerated by a refrigerant medium including a

liquid species selected from the group consisting of liquid nitrogen, liquid oxygen and liquid fluorine.

28. The method of claim 26, comprising delivering the source gas to the cryotrap via a valved manifold assembly, which is controllably operated to close the cryotrap to flow to the vessel during said liquefying step (b), and to close the cryotrap to introduction of source gas during said gasifying step (c).

29. The method of claim 25, wherein the vessel comprises a closed vessel having a gas dispensing assembly coupled thereto for selective discharge of gas from the vessel subsequent to fill of the vessel to said predetermined pressure level.

30. The method of claim 29, wherein the vessel has a gas regulator interiorly disposed in said closed vessel, whereby gas is selectively dispensable from the vessel at a pressure determined by a set point of said gas regulator.

31. The method of claim 25, wherein the source gas comprises a gas species selected from the group consisting of arsine, phosphine, stibine, silanes, disilanes, halosilanes, diborane, hydrogen fluoride, boron trichloride, boron trifluoride, hydrogen chloride, and organometallic reagent gases.

32. The method of claim 26, wherein the cryotrap is refrigerated by a refrigerant medium including liquid nitrogen, and the source gas comprises boron trifluoride.